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WALTER W. LAABS JR., P. E. CONSULTING TRAFFIC ENGINEER

Labs, walter w

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REVIEW OF TRAFFIC SOLUTIONS,
CITY OF SEBASTOPOL

This report will review various traffic solutions proposed to reduce congestion at the main intersection of Main Street, Bodega Avenue and Sebastopol Avenue. All of the solutions examined utilize existing streets.

METHODOLOGY

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Level of Service

The level of service concept is used to describe conditions of traffic operations. Six levels of service have been selected for application identifying the conditions existing under various speed and volume conditions on any highway or street. These levels of service, designated A to F, from best to worst, cover the entire range of traffic operations that may occur. On many specific streets and highways, the better levels cannot be attained. (Ref. 1)

The concept of level of service was introduced in the <u>Highway Capacity Manual</u>. Definitions for level of service for intersections are included in the appendix. Level of service for intersections is dependent upon overall delay. The concept of delay is the one most readily identified by drivers.

For planning purposes future traffic can be estimated within reasonable limits. The relationship between volume and delay for intersections has been the subject of extensive research. Since the <u>Highway Capacity Manual</u> was published in 1965 there have been later studies containing revised or expanded methods for determining levels of service for intersections. However, the concept (levels A through E, best to worst) has not changed.(Ref. 2)

Peak Hour Analysis

The level of service concept is related to traffic during the peak hour. In

Sebastopol the daily peak hour occurs in the afternoon, most commonly 4:30 to 5:30 PM. For this reason the analyses are done for PM peak hour traffic conditions.

Critical Volume Analysis

The method of analysis for determining the level of service of an intersection is to determine the critical lane volume for each signal phase. The sum of the critical volumes are compared to the capacity of the intersection to find level of service for that intersection. The relationship between level of service, volume to capacity and average delay are summarized below. (Ref. 2)

Level of	Traffic Flow	Critical Volume to Capacity Ratios	Average Delay (seconds per
<u>Service</u>	Description	(v/c)	<u>vehicle)</u>
Α	Free Flow	060	0 - 16.0
В	Stable Flow	.6170	16.1 - 22.0
C	Stable Flow	.7180	22.1 - 28.0
D	Approaching Unstable Flow	.8190	28.1 - 35.0
E	Unstable Flow	.91 - 1.00	35.1 - 40.0
F	Forced Flow	varies	40.1 or greater

Capacity

The capacity of a signalized intersection is the maximum number of vehicles that could pass through the intersection in an hour under prevailing conditions. The values for capacity vary with the number of phases of the signal. The more phases that a signal has the less the capacity of a signalized intersection. This is due to the delays in acceleration at the beginning of a phase and the yellow clearance time at the end of a phase. The values used for capacity of a signalized intersection for planning purposes are listed on the following page. (Ref. 2)

Number of Phases	Capacity				
`2	1500 vehicles per hour				
3 (1425 vehicles per hour				
4 or more	1375 vehicles per hour				

Base Data

As stated above the determination of Level of Service for a signalized intersection is based upon an analysis of turning movements during the PM peak hour. The most comprehensive data was collected in April 1980 by Caltrans. Turning movement counts were collected at all of the intersections that will be analyzed over a 12 hour period. The peak hour began at either 4:30PM or 4:45PM. A summary of the evening peak hour counts for April 1980 is included in the appendix.

Traffic Growth Rate

The growth in traffic projected in the County Transportation Study for the Sebastopol Area was at an annual rate of 2.45%. The actual growth rate of traffic between 1980 and 1982 ranges from an annual rate of 2.9% on Main Street (State Highway 116) north of Bodega Avenue and Sebastopol Avenue to an annual rate of 9.2% on Sebastopol Avenue (State Highway 12) east of Main Street.

In order to determine an estimate of present (1983) traffic the lower growth rate of 2.9% per year will be used. For future growth the projected growth rate of 2.45% per year will be used.

If traffic grows at a higher rate than projected the conditions described herein will occur sooner than anticipated.

PRESENT SITUATION

Main Street, Bodega Avenue, Sebastopol Avenue

The present traffic signal controller is an electro-mechanical pre-timed controller. The timing of the signal is accomplished by one of three dials. Each dial can be set with an individual split and/or cycle length. The selection of the dial in use is accomplished by a time-of-day clock.

The traffic signal has two phases: one for north/south movement and one for east/west movement. There is no separate left turn phase. A driver making a left turn must wait for a gap in the opposing traffic stream. During the peak periods, when there are no gaps, drivers make left turns during the yellow clearance interval. An average of two vehicles per cycle can make this movement.

Based on the 1980 traffic volumes the signalized intersection was operating at Level of Service C or 75% of capacity. Using a growth rate of 2.9% per year the signalized intersection now operates at Level of Service D or 82% of capacity. It is important to note that the demand for southbound left turns exceeds capacity during the evening peak hour.

Using a growth rate of 2.45% per year for the period beyond 1983, the traffic volumes will be such that the intersection will operate at Level of Service E by 1987 and reach capacity by 1992.

Main Street, McKinley Street

The traffic signal controller is a solid state, traffic actuated controller. It is interconnected to the pre-timed controller at Main Street, Bodega Avenue and Sebastopol Avenue. There is no separate left turn phase at this intersection. Unlike the signal at Main Street, Bodega Avenue and Sebastopol Avenue, the pedestrian phase only occurs when actuated. Depending upon the number of pedestrian actuations during the peak hour the intersection will operate between Level of Service B and Level of Service C. The greater the

number of pedestrian cycles utilized during the peak hour the greater the delays to through traffic.

SCENARIO 1: Install Signal at Petaluma Avenue and Sebastopol Avenue.

Petaluma Avenue, Sebastopol Avenue

The new traffic signal at this location will be state-of-the-art, solid state, fully traffic actuated. If Petaluma Avenue remains as a two-way street the new traffic signal will operate as 6 phase, "dual left", split cross street. Eastbound and westbound left turns will have separate phases before the eastbound and westbound through phases. Northbound movements, left and through will be a separate phase from southbound movements. Northbound right turns will be controlled by a yield sign.

With two-way operation on Petaluma Avenue, a signalized intersection will operate at Level of Service B.

Main Street, Bodega Avenue, Sebastopol Avenue

No changes to this intersection are assumed under this scenario.

Main Street, McKinley Street

No changes to this intersection are assumed under this scenario.

SCENARIO 2: Modernize Existing Signals

Main Street, Bodega Avenue, Sebastopol Avenue

A new traffic signal controller at this intersection would be state-of-theart, solid state, fully traffic actuated. If both Main Street and Bodega Avenue/Sebastopol Avenue remain as two-way streets a new traffic signal will operate as 8 phase "quad left". Separate left turn phases in advance of the associated through phase would be provided. There would be no vehicle conflicts on any traffic phase. With the existing geometry and estimated 1983 traffic volumes the intersection would operate at the upper threshhold of Level of Service D, near Level of Service E.

There would be an average delay of 35 seconds per vehicle. There is enough storage capacity in the left turn lanes to handle the left turn volumes, however there is not sufficient distance between intersections on Main Street to handle through traffic. A distance of 475 feet would be required to store northbound through traffic. The distance to Burnett Street is 200 feet. A distance of 425 feet would be required to store southbound vehicles. The distance to McKinley Street is 360 feet. Both adjacent intersections would be plugged by traffic on every cycle during the peak hour.

Main Street, McKinley Street

1

The addition of an actuated left turn phase would add to the convenience of drivers but would not improve the operation of the intersection. The intersection would operate at Level of Service C during the evening peak hour.

Petaluma Avenue, Sebastopol Avenue

This intersection would operate as was described in Scenario 1.

SCENARIO 2a: Balance Movements

A new signal is installed at Petaluma Avenue and Sebastopol Avenue and actuated left turn phases are added to the signal at Main Street, Bodega Avenue, Sebastopol Avenue and at Main Street and McKinley Street.

When this is done there will be some redistribution of traffic. Some drivers now making a southbound to eastbound left turn at Main Street, Bodega Avenue, Sebastopol Avenue will make a left turn at Main Street and McKinley Street and another left turn at Petaluma Avenue and Sebastopol Avenue. Some drivers travelling northbound on Main Street will shift to Petaluma Avenue. The amount of redistribution will be such that the flows will be balanced, i.e.,

northbound left turns equal southbound left turns and northbound through movements equal southbound through movements.

Main Street, Bodega Avenue, Sebastopol Avenue

There will be a decrease in critical volumes at this intersection. The volume to capacity ratio will decrease from 0.89 to 0.81. The intersection will still operate at Level of Service D. The average delay will be about 28 seconds per vehicle.

At a growth rate of 2.45% per year traffic volumes will be such that the volume to capacity ratio will exceed 0.90 in 5 years. A volume to capacity ratio of 0.90 is the threshhold value of Level of Service E.

Because southbound through traffic will not shift, a storage length of 425 feet is still needed for southbound traffic. McKinley Street would be blocked by waiting vehicles.

Main Street, McKinley Street

The shift of traffic, will have very little effect on this intersection. Some northbound through traffic will be shifted to westbound to northbound right turns. Some southbound through traffic will be shifted to southbound left turns. The intersection will continue to operate at Level of Service C during the evening peak hour.

Petaluma Avenue, Sebastopol Avenue

The shift of traffic will add traffic to this intersection, mainly northbound through traffic. The intersection will operate at Level of Service C during the evening peak hour.

SCENARIO 3: Remove Parking - Main Street

There are only two ways to reduce lane volumes. One is to reduce volumes by diverting traffic. The other is to increase the number of lanes. The number

of through traffic lanes on Main Street can be increased by removing parking.

Main Street, Bodega Avenue, Sebastopol Avenue

The operation of this intersection would be improved to the upper threshhold of Level of Service B, near Level of Service C with the prohibition of parking on both sides of Main Street. The prohibition would only have to be between Burnett Street and McKinley Street to be effective. At an annual growth rate of 2.45% traffic lane volumes would reach the present level by 1994.

Removal of parking on only the west side of Main Street would not improve the operation of the intersection. The intersection would operate at Level of Service D, near Level of Service E, as is the case with parking permitted on both sides of the street.

Removal of parking on only the east side of Main Street would improve the operation of the intersection. The intersection would operate at the upper threshhold of Level of Service C, near Level of Service D. At an annual growth rate of 2.45% traffic lane volumes would reach the present level by 1988.

Main Street, McKinley Street

Since parking would not have to be removed north of McKinley Street the intersection would operate the same as in Scenario 2.

Petaluma Avenue, Sebastopol Avenue

This intersection would operate as in Scenario 1.

SCENARIO 4: Prohibit Left Turns Northbound and Southbound. No additional signals.

One way to reduce critical volumes is to eliminate movements. In this scenario it is assumed that a signal has been installed at Petaluma Avenue and Sebastopol Avenue and that the signal at Main Street and McKinley Street has

The situation could be improved slightly by the addition of a second lane southbound. The intersection would then operate at the lower threshhold of Level of Service D, just above Level of Service C.

SCENARIO 5: North-South One-Way Couplet

With the north-south couplet all southbound traffic will use Main Street. There will be two southbound lanes at McKinley Street increasing to three southbound lanes at Bodega Avenue, Sebastopol Avenue. At Burnett Street there will be two southbound through lanes and one southbound left turn lane.

All northbound traffic will use Petaluma Avenue. There will be two northbound lanes. There will be an additional right turn lane at Sebastopol Avenue.

Main Street north of McKinley Street will be two-way operation. McKinley Street east of Main Street will have two lanes one for right turns and one for left turns.

Main Street, Bodega Avenue, Sebastopol Avenue

The operation of the intersection will improve to Level of Service C, just above the threshhold of Level of Service B. Delays will be reduced to an .E

average of 23 seconds per vehicle. At a growth rate of 2.45% per year traffic will not reach present levels until 1992.

Main Street, McKinley Street

The operation of the intersection will improve to Level of Service C.

Petaluma Avenue, Sebastopol Avenue

The intersection will operate at Level of Service C with the additional traffic diverted from Main Street. This is one level lower than would be the case if Petaluma Avenue were two-way operation. At a growth rate of 2.45% per

year the intersection would reach the threshhold between Level of Service D and Level of Service E by 1989.

SCENARIO 5a: North-South One-Way Couplet (Main Street Northbound, Petaluma Avenue Southbound)

This is a reverse one-way couplet. Northbound traffic will use Main Street and southbound traffic will use Petaluma Avenue. A traffic signal is needed at Main Street, Petaluma Avenue and Gravenstein Highway South.

Main Street, Petaluma Avenue, Gravenstein Highway South

A traffic signal at this location would operate at Level of Service E with the present geometry, i.e., 3 lanes on Gravenstein Highway South. If Gravenstein Highway south were widened to 4 lanes south of the intersection the service level could be improved to Level of Service B. The widening would have to extend for a sufficient length to allow southbound traffic to merge into one lane.

Main Street, Bodega Avenue, Sebastopol Avenue

The intersection would operate at Level of Service B during the peak hour.

The reason for the improvement is that the eastbound to northbound left turns that would have to be accommodated in this scenario are less than the westbound to southbound left turns that are handled under Scenario 5, Main Street southbound.

Main Street, McKinley Street

The intersection will operate at Level of Service D during the peak hour. If Main Street is re-marked to provide two lanes in each direction, the intersection will operate at Level of Service A.

Petaluma Avenue, Sebastopol Avenue

The intersection will fail during the peak hour. The reason for the failure is that the northbound to eastbound right turn, which was handled as a free right turn under Scenario 5, now becomes an eastbound through movement under Scenario 5a. The intersection could not handle the projected traffic without an extensive street widening project.

SCENARIO 6: Both Couplets

With both couplets north-south traffic will use the routes as described in Scenario 5. East-west traffic will also be split. Eastbound traffic will use South High Street, Burnett Street and Petaluma Avenue. Westbound traffic will use Sebastopol Avenue and Bodega Avenue.

New traffic signals will be needed at South Main Street and Burnett Street and at Petaluma Avenue and Burnett Street.

Both Burnett Street and South High Street (between Bodega Avenue and Burnett Street) would have to be reconstructed to handle increased traffic, especially truck traffic.

Main Street, Bodega Avenue, Sebastopol Avenue

The operation of the intersection will improve to Level of Service A. Delays will be reduced to an average of less than 16 seconds per vehicle. At a growth rate of 2.45% per year traffic will not reach present levels until 2004.

Main Street/McKinley Street

The operation of the intersection will be the same as with only the north-south couplet. The intersection will operate at Level of Service B or C depending upon the number of pedestrian actuated phases during the peak hour. At a growth rate of 2.45% per year the intersection would reach the threshhold between Level of Service D and Level of Service E by 1998.

Petaluma Avenue, Sebastopol Avenue

The operation of this intersection will be improved to Level of Service B. This is the same level that would be the case if Petaluma Avenue were a two-way operation. At a growth rate of 2.45% per year the intersection would reach the threshhold between Level of Service D and Level of Service E by 1997.

South Main, Burnett Street

A new signal would be needed at this intersection. At 1983 traffic volumes the intersection would operate at Level of Service A. At a growth of 2.45% per year the intersection would not reach the threshhold between Level of Service D and Level of Service E until 2005.

Petaluma Avenue, Burnett Street

A new signal would be needed at this intersection. At 1983 traffic volumes the intersection would operate at Level of Service A. At a growth rate of 2.45% per year the intersection would not reach the threshhold between Level of Service D and Level of Service E until 2007.

REFERENCES

- 1. Highway Research Board, Highway Capacity Manaual, Special Report #87, 1965.
- 2. Transportation Research Board, <u>Interim Materials on Highway Capacity</u>, Circular #212, January 1980.

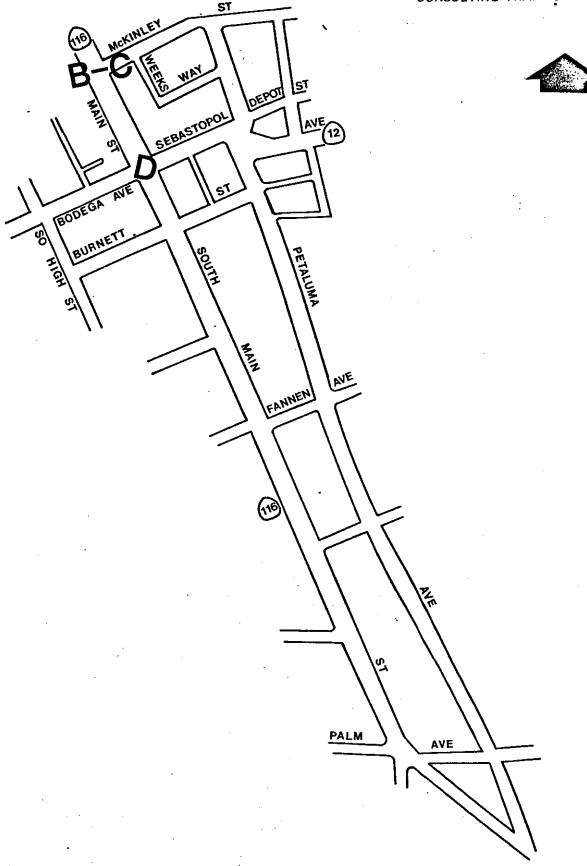
SUMMARY OF TRAFFIC SOLUTIONS

			٧٠	s until				
TRAFFIC SOLUTION	C V	v/c		v/c=.90				
PRESENT SITUATION	•	., 0	200	., 0 .20				
Main/Bodega/Sebastopol -	1224	.82	D					
Main/McKinley	1009-1136	.6776	B-C					
Petaluma/Sebastopol	not	signalized						
SCENÁRIO 1: Signal at Petaluma/S	ebastopol							
Main/Bodega/Sebastopol	1224	.82	D					
Main/McKinley	1009-1136	.6776	B-C					
Petaluma/Sebastopol	922	.67	В.	13				
SCENARIO 2: Modernize Signals								
Main/Bodega/Sebastopol	1224	.89	D	1				
Main/McKinley	1008-1170	.7182	C-D	10				
Petaluma/Sebastopol	922	.67	В	13				
•								
SCENARIO 2a: Balance Movements			_	_				
Main/Bodega/Sebastopol	1114	.81	D	5				
Main/McKinley	996-1158	.70 .75	C-D C	11 8				
Petaluma/Sebastopol	1032	.75	U	0				
SCENARIO 3: Remove Parking Main	St							
Main/Bodega/Sebastopol	960	.70	В	11				
Main/McKinley	1008-1170	.7182	C-D	10				
Petaluma/Sebastopol	922	.67	В	13				
SCENARIO 3a: Remove Parking West	side Main St							
Main/Bodega/Sebastopol	1224	.89	D	1				
Main/McKinley	1008-1170	.7182	C-D	10				
Petaluma/Sebastopol	922	. 67	В	13				
SCENARIO 3b: Remove Parking East side Main St								
Main/Bodega/Sebastopol	1114	.81	D	5				
Main/McKinley	1008-1170	.7182	C-D	10				
Petaluma/Sebastopol	922	. 67	В	13				
COPNEDIO A. D. Libit NA Chiles	h Tourne of Main	n /Dodosa /So	hastonal					
SCENARIO 4: Prohibit Nb, Sb Left	t turns at Mati 1285		bas copo i	0				
Main/Bodega/Sebastopol Main/McKinley	1277-1439		D-E	1				
Petaluma/Sebastopol	1277 1405	.94	Ē	Ō				
i cou i ama, ocoas copo.			_	·				
SCENARIO 4a: Same as 4; add lane			_					
Main/Bodega/Sebastopol	966		Č	11				
Main/McKinley	1133-1295		D-E	6 5				
Petaluma/Sebastopol	1108	.81	D	5				
SCENARIO 5: North-South One Way								
Main/Bodega/Sebastopol	1022		C	10				
Main/McKinley	951		В	15				
Petaluma/Sebastopol	1112	.78	C	. 6				

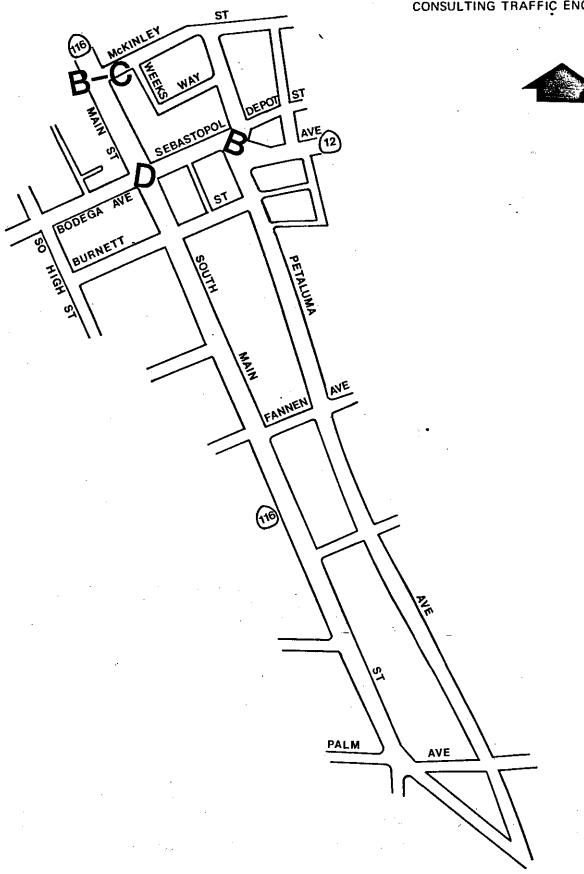
SUMMARY OF TRAFFIC SOLUTIONS (continued)

TRAFFIC SOLUTION	CV	v/c	Yrs u LOS v/c	intil :=.90
	Ο,	٧, ٥	200 170	
SCENARIO 5a: North-South One-Way Couplet Main St Nb, Petaluma Ave Sb				
Main/Petaluma/Gravenstein Hwy So	1367	.91	Ε	0
Main/Bodega/Sebastopol	941	.66	В	13
Main/McKinley	1269	.85	D	3
Petaluma/Sebastopol	1690	1.19	Fail	0
SCENARIO 5b: North-South One-Way Couplet Main St Nb, Petaluma Ave Sb Add Lanes				
Main/Petaluma/Gravenstein Hwy So	927	.62	В	16
Main/Bodega/Sebastopol	941	.66	В	13
Main/McKinley	881	.59	Α	18
Petaluma/Sebastopol	1497	1.05	Fail	0
SCENARIO 6: Both Couplets				
Main/Bodega/Sebastopol	813	.54	Α	21
Main/McKinley	951	.63	В	15
Petaluma/Sebastopol	971	.65	В	14
So Main/Burnett	798	.53	Α	22
Petaluma/Burnett	766	.51	A	24

C V = Sum of Critical Volumes v/c = Volume to capacity ratio LOS = Level of Service

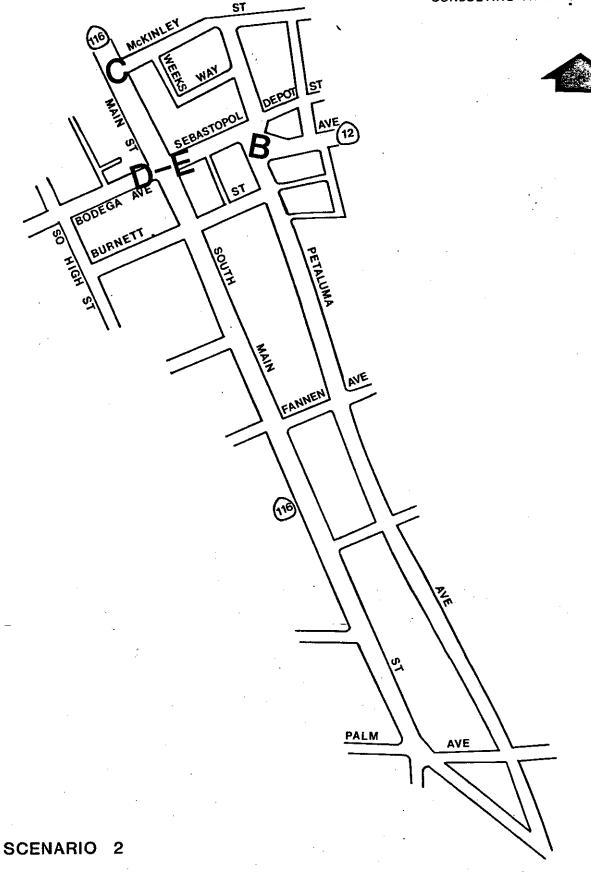


Present Situation

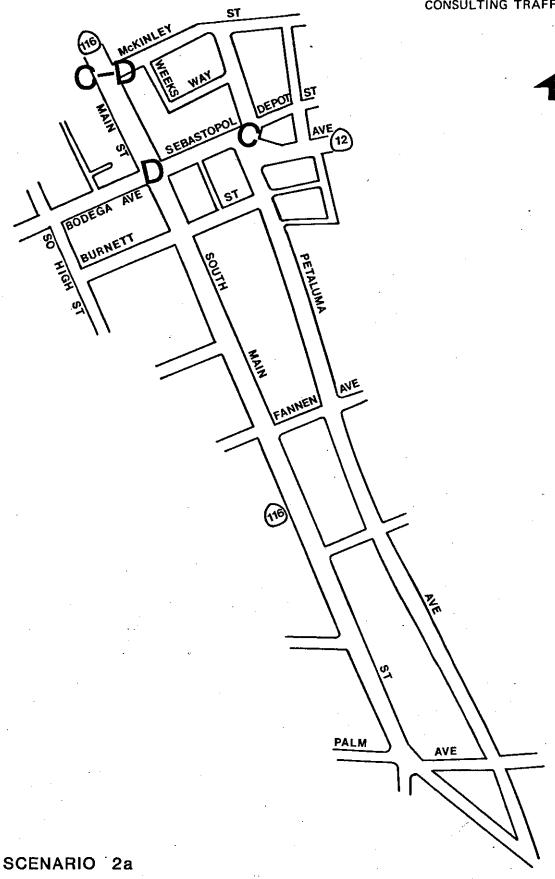


SCENARIO 1
New signal at Petaluma Avenue
and Sebastopol Avenue

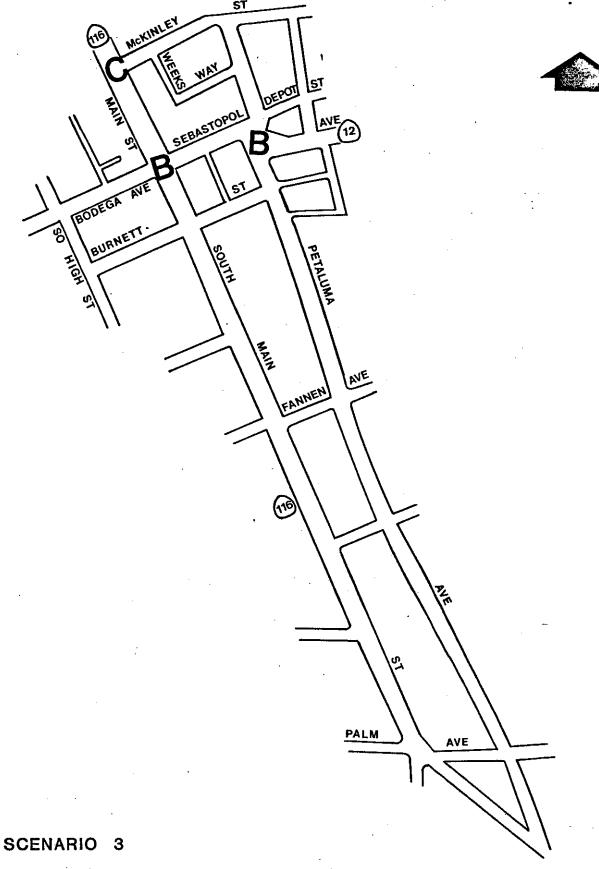
WALTER W. LAABS JR., P. E. CONSULTING TRAFFIC ENGINEER



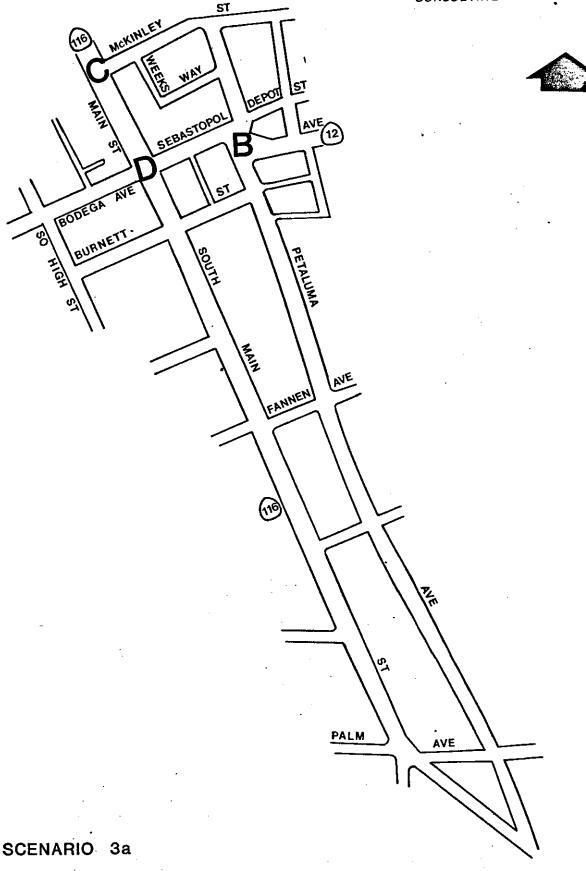
Modernize Existing Signal



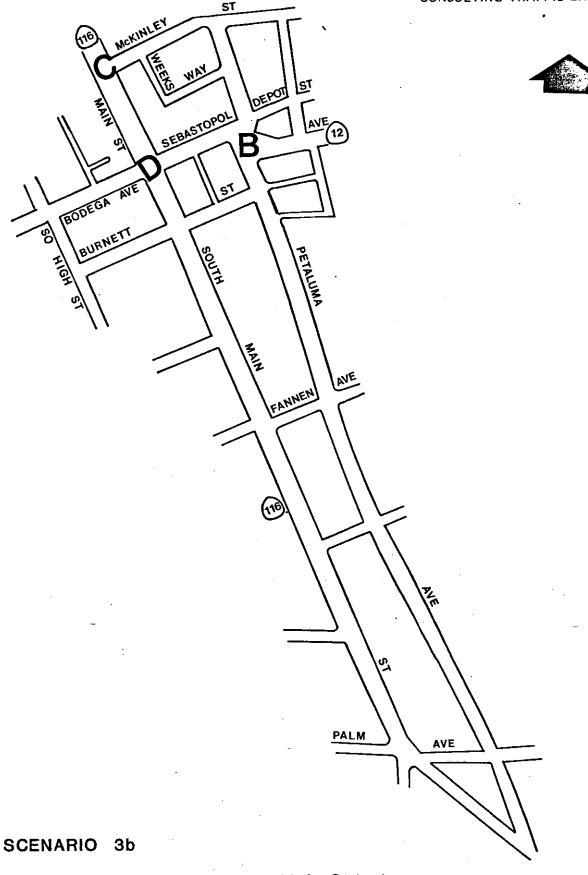
Balance Movements



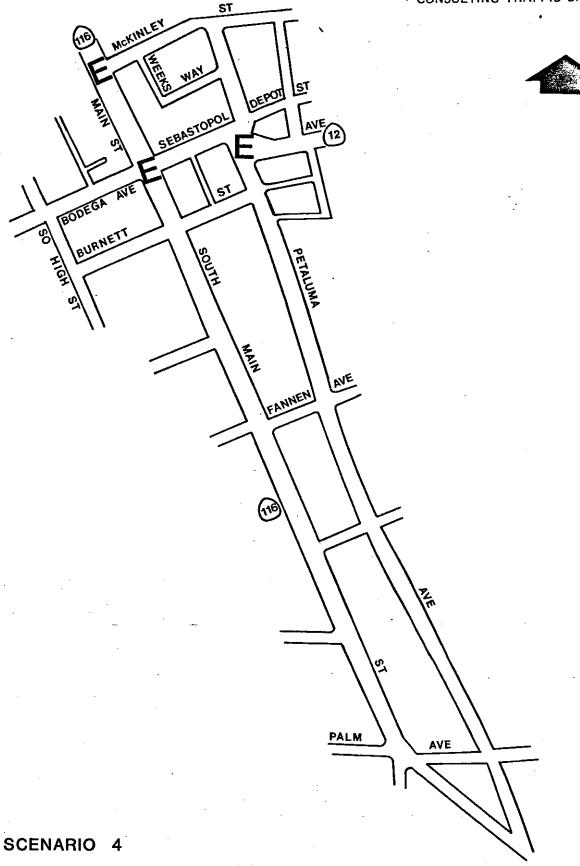
Eliminate Parking Both Sides -Main Street



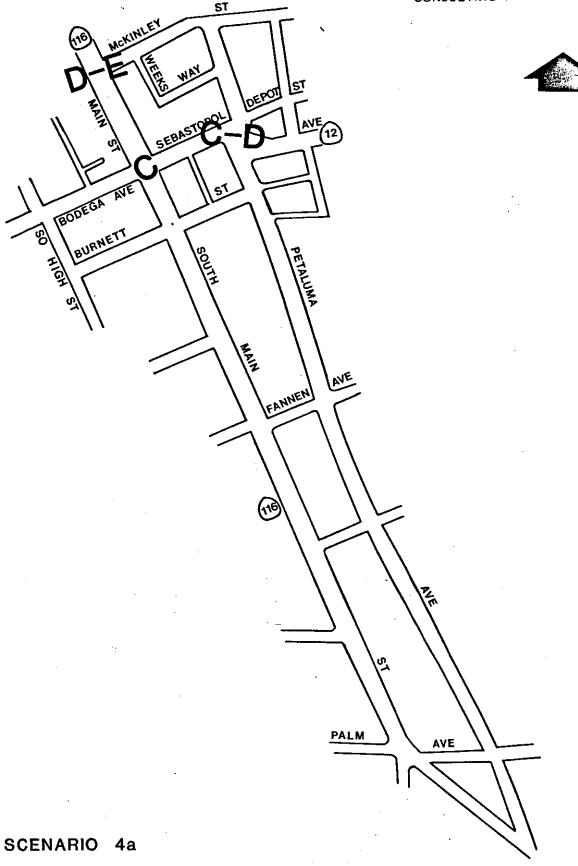
Eliminate Parking West Side - Main Street



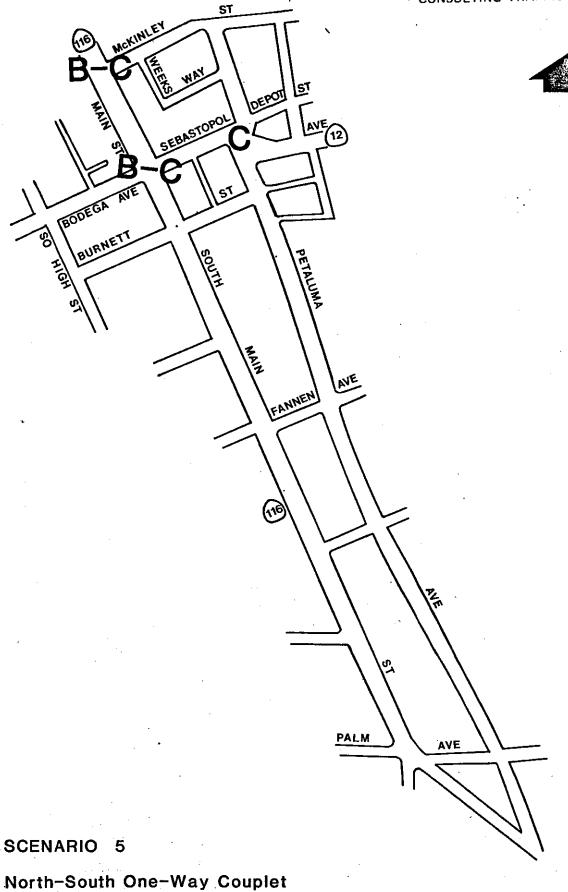
Eliminate Parking East Side - Main Street

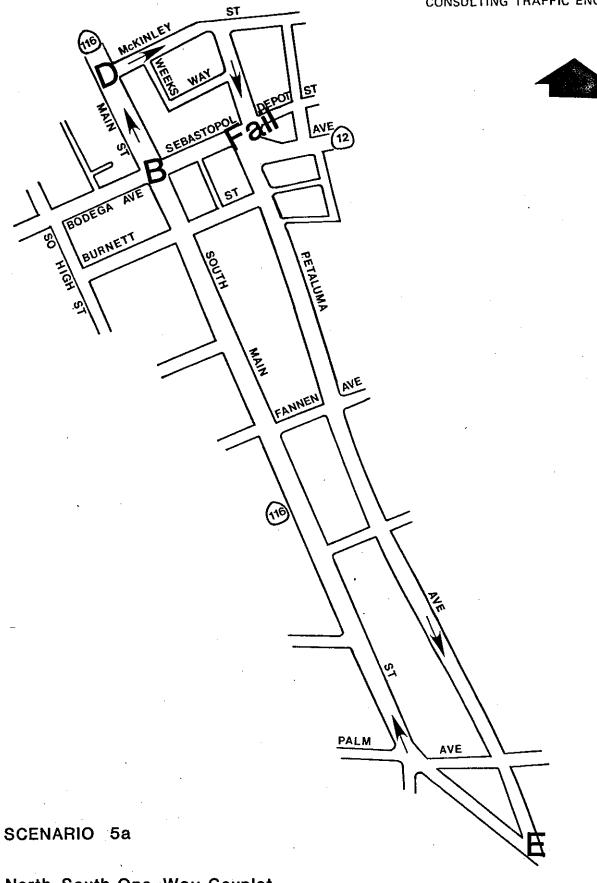


Prohibit Northbound and Southbound Left Turns at Main/Bodega/Sebastopol

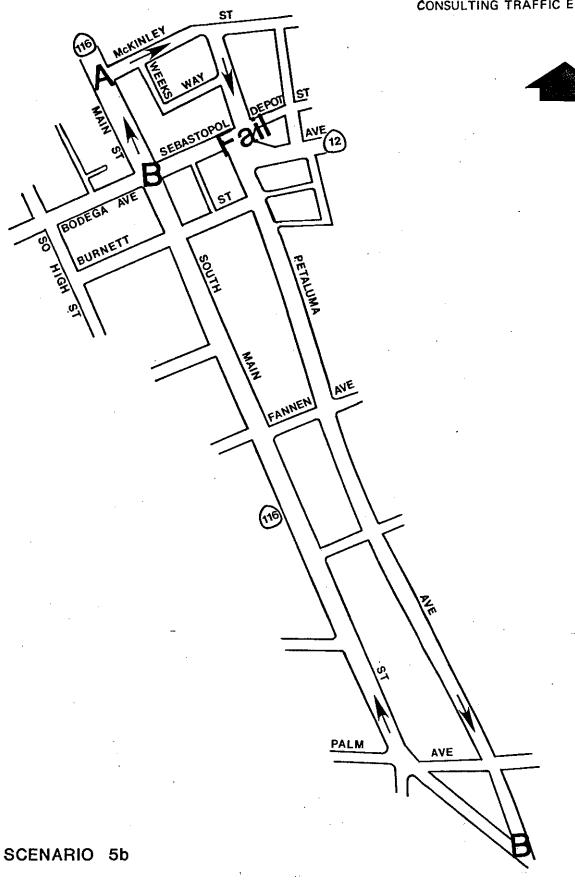


Prohibit Northbound and Southbound Left Turns at Main/Bodega/Sebastopol Add Lanes

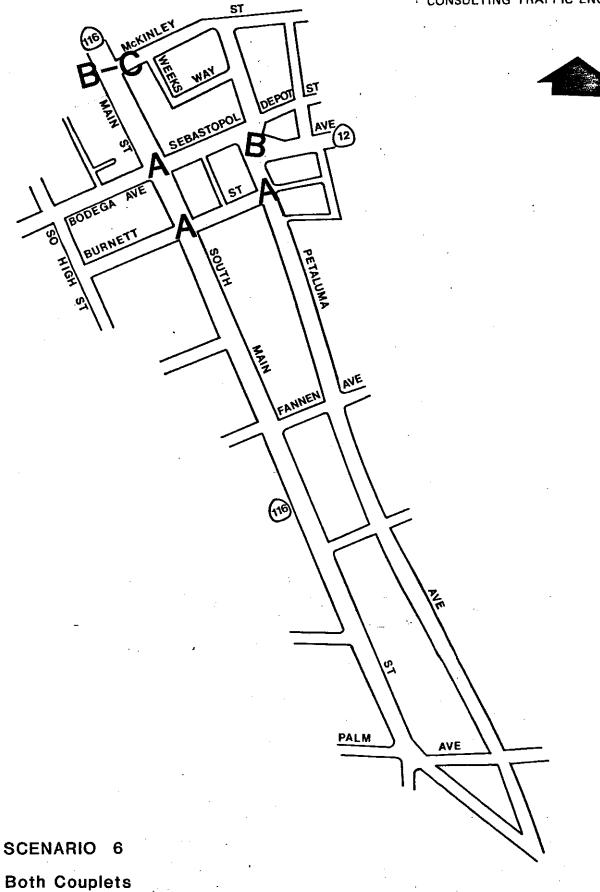




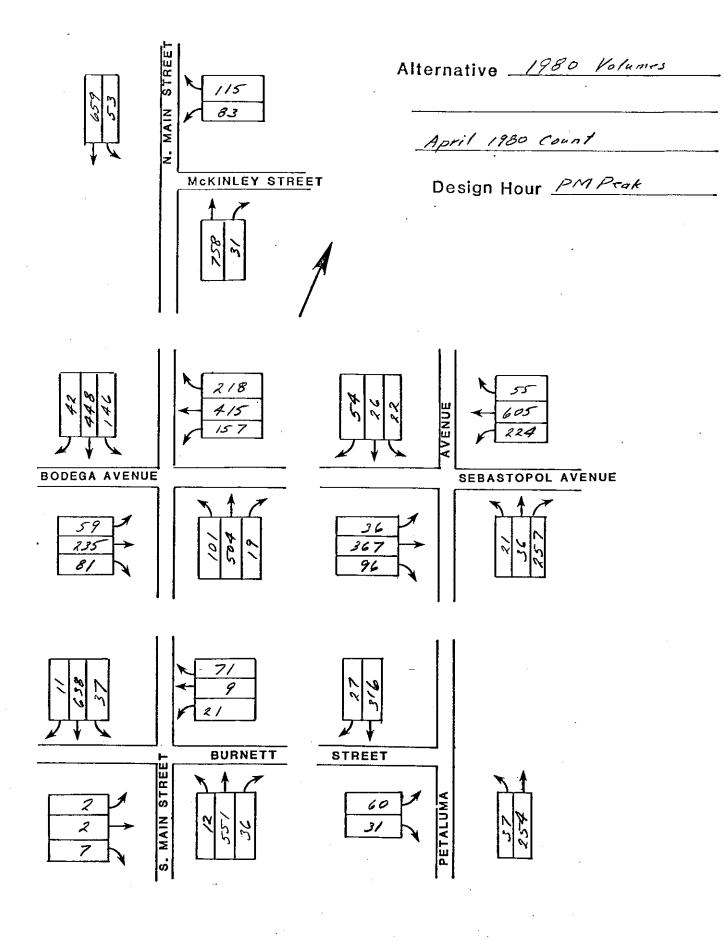
North-South One-Way Couplet Main Street Nb Petaluma Avenue Sb



North-South One-Way Couplet Main Street Nb Petaluma Avenue Sb Add Lane



APPENDIX

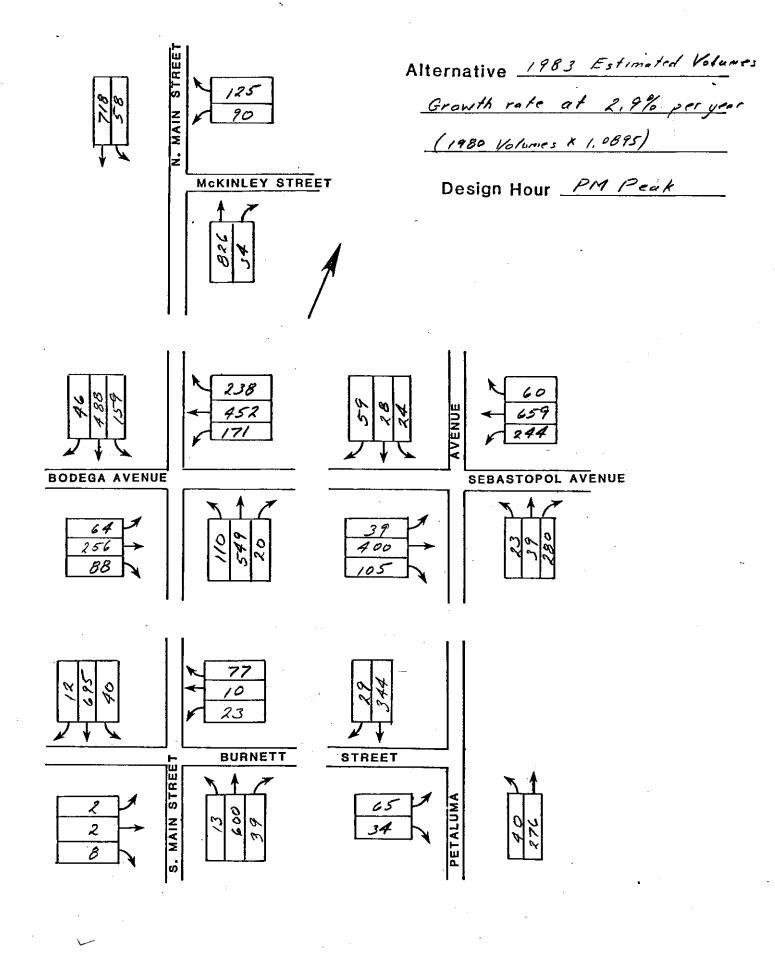


Critical Movement Analysis: PLANNING WALTER W. LAABS JR., P.E. Calculation Form 1

Problem Statement Existing Conditions 1980 Volumes

Step 1. Identify Lane Geometry	Step 4. Left Turn Check	Step 6b. Volume Adjustment for		
	60 sec cycle	Multiphase Signal Overlap		
Approach 3	Approach	Possible Volume Adjusted Probable Critical Carryover Critical		
N 1 3 April 100	1 2 3 4	Phase Volume to next Volume		
	a Number of change intervals 60 60 60 60	in vph phase in vph		
Bodrya Av JIL SeBostopal As	per hour b. Left turn capacity on change interval, 120 120 120 120	2φ		
	in vph			
bact ,	Ratio			
Approach 1	in vph 632 376 373 490			
4 4	c. Left turn capacity on O 284 77 110			
1 116	f. Left turn	·		
	capacity in vph 120 404 197 230 (b + e)			
\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	g. Left turn volume 59 157 146 101	·		
Approach 4	h. Is volume > capacity (g > f)? No No No No			
Step 2. Identify Volumes, in vph	Step 5. Assign Lane Volumes,	Step 7. Sum of Critical Volumes		
In I Approach 3	in vph	59 . 415 . 146 . 504		
Approach 3	Approach 3	l '		
TH = 415		= <u>//2 #</u> vph		
LT = <u>157</u>	44	Step 8. Intersection Level of		
		Service		
200	2/8 0	(compare Step 7 with Table 6)		
Coac	08 59 157 DB	V/c:0.75 C		
Approach 1	Approach 2/2 / 2/2			
-1		Step 9. Recalculate		
		Geometric Change		
$LT = \frac{59}{235}$ $RT = \frac{81}{100}$	280	Signal Change		
IH =		1 · . ·		
Approach 4 LE	Approach 4	Volume Change		
Step 3. Identify Phasing 20	Step 6a. Critical Volumes, in vph	Comments		
	· (two phase signal)			
-> A182 or A2 B1	Approach 3			
A182 or A2 B1 A384 or A483				
A384 or A483	26	Table 6. Level of Service Ranges		
	J	PLANNING Applications (in vph)		
	12	Level Maximum Sum of Critical Volumes		
	Approach 2	of Two Three Four or Service Phase Phase more Phase		
	baron see	Service Phase Phase more Phases A 900 855 825		
	 	B 1050 1000 965		
1		C 1200 1140 1100		
]	D 1350 1275 1225		
A1 A3 B1 B3		E 1500 1425 1375		
A2 A4 B2 B4 L	Approach 4	Fnot applicable		

Source: TRB Circular 212



Critical Movement Analysis: PLANNING Calculation Form 1

Intersection Main. St & Sebastopol Are & Badega Ave Design Hour PM Peak 9 Problem Statement Existing Conditions 1983 Estimated Volumes Step 1. Identify Lane Geometry | Step 4. Left Turn Check Step 6b. Volume Adjustment for 60 sec cycle Multiphase Signal Overlap Possible Volume Adjusted Approach 3 Approach Critical Probable Carryover NT Phase Volume to next in vph a. Number of change intervals per hour b. Left turn capacity 120 120 on change interval, 120: 120 in vph Approach 1 c. G/Ċ Ratio d. Opposing volume 690 344 569 5X in vph e. Left turn capacity on green, in vph f. Left turn 120 376 151 186 capacity in vph (b + c) . Left turn volume in vph h. Is volume > capac-ity (g > f)? Approach 4 Step 7. Sum of Critical Volumes Step 2. Identify Volumes, in vph Step 5. Assign Lane Volumes, in vph 152 . 159 . 549 Approach 3 = 1224 TH = 452 LT = 171 Step 8. Intersection Level of Service (compare Step 7 with Table 6) 8ري ا V/C= 0,82 64 344 -Step 9. Recalculate Geometric Change _ Signal Change Volume Change ___ Step 3. Identify Phasing 2 p Step 6a. Critical Volumes, in vph **Comments** (two phase signal) Sb. Left turns excede Approach 3 Table 6. Level of Service Ranges PLANNING Applications (in vph) Maximum Sum of Critical Volumes Leve1 Three Four or Phase more Phases Phase <u>S</u>ervice: 900 855 825 1050 1000 965 В C 1200 1140 1100 1225 D 1350 1275 **B3** Ε 1500 1425 1375 B2 __ B4 L -not applicable-Approach 4

Reference: TRB Circular 212, Interim Materials on Highway Capacity, 1980 WALTER W. LAABS JR., P.E. CONSULTING TRAFFIC ENGINEER

Coloulation Form 1

Calculation Form 1

_____ Design Hour P.M Peak Intersection Main Street & Mc Kinley St Problem Statement Existing Conditions 1983 Estimated Volumes Step 1. Identify Lane Geometry | Step 4. Left Turn Check Step 6b. Volume Adjustment for Multiphase Signal Overlap Adjusted Possible Volume Approach 3 Critical Probable Carryover Volume in vph a. Number of change intervals per hour Pedestrian Minimum across b. Left turn capacity on change interval. Main Street. in vph Actuated c. G/C 7+50 -3: 16,5 sec or 7 veh / cycle Ratio d. Opposing volume in vph e. Lest turn capacity on green, in vph 100 second cycle f. Left turn capacity in vph Ped equivalent = 252 veh/hr g. Left turn volume in vph h. Is volume > capacity (g > f)? Approach 4 Step 7. Sum of Critical Volumes Step 2. Identify Volumes, in vph Step 5. Assign Lane Volumes, 0-252 (Ped) in vph 826.125. Approach 3 Approach 3 RT = 125 1136 = 1009 ,67 LT = 90 두 Step 8. Intersection Level of Service (compare Step 7 with Table 6) B-C Step 9. Recalculate Geometric Change ... Signal Change _ Volume Change _ Step 3. Identify Phasing Step 6a. Critical Volumes, in vph Comments (two phase signal) B3 A4 Approach 3 A2 B1 Table 6. Level of Service Ranges PLANNING Applications (in vph) Maximum Sum of Critical Volumes Level 125 Three Four or more Phases Phase Service Phase 855 825 900 1050 1000 965 C 1200 1140 1100 1350 1225 D 1275 - B3 **~**↑ 1500 1375 1425 -----not applicable-B2 __ B4 L

Reference: TRB Circular 212, Interim Materials on Highway Capacity, 1980 WALTER W. LAABS JR., P.E. CONSULTING TRAFFIC ENGINEER

CRITICAL MOVEMENT ANALYSIS (6 Phase Dual Left Split Cross Street Signal)

Intersection: A: Sebasi B: Sebasi C: Petalu D: Petalu Design Hour: Problem Statema	topol uma Av uma Av P	Avenue enue enue M Peak	Et Wh Nt Sh ated Volu)))		A	D C	(1)	В
Movement	÷	Lanes	Volume	Lane Volume					
A Left Turn A Through A Right Turn	5 2	1 .5 .5	39 400 105	39 505 0					
B Left Turn B Through B Right Turn	1 6	1 1.5 .5	244 659 60	244 360 0					
C Left Turn C Through C Right Turn	3 8	.5 .5 1	23 39 280	0 62 280	,				
D Left Turn D Through D Right Turn	7 4	.3 .4 .3	24 28 59	0 111 0					
	hase 1+5	ritical Volume 39 205 505	Carry- over 205 155						
	4+7	111 _	0						
8 RT (Sum of Crit. V Volume/Capacit Level of Servi	ol.: y:	62 922 0.67 B	218 TRUE		· ·			LEVEL CE RAN + phas	IGES
Annual Growth Years Before:	Rate	2.45 % c exceeds 0.60 0.70 0.80 0.90 1.00				Se	Level of ervice A B C D	Criti Volu 1	

Ref: Interim Materials on Highway Capacity, TRB Circular 212, Jan 1980

CRITICAL MOVEMENT ANALYSIS (8 Phase Quad Left Signal)

Intersection: A: Bodega Ave B: Sebastopol C: South Main D: Main Stree Design Hour: Problem Statement:	l Avenue n Street et P M Peak	Et Wt Nt St ated Volu			A		В
Movement	Lanes	Volume	Lane Volume				
A Left Turn 5 A Through 2 A Right Turn	.5 .5	64 256 88	64 344 0				
B Left Turn 1 B Through 6 B Right Turn	1 1 1	171 452 238	171 452 238	·			
C Left Turn 3 C Through 8 C Right Turn	1 1 1	110 549 20	110 549 20	,			
D Left Turn 7 D Through 4 D Right Turn	1 1 1	159 488 46	159 488 46	·			
Probable Phase 1+5 1+6 or 2+5 6+2	64 107	Carry- over 107 345					
3+7 3+8 or 4+7 4+8	110 49 549	49 439				LEVEL (OF
Sum of Crit. Vol.: Volume/Capacity: Level of Service:	1224 0.89 D					CE RANGI + phase:	ES s)
Annual Growth Rate Years Before: NA NA NA 1	v/c exceeds 0.60 0.70 0.80 0.90				Level of Service A B C D		a1 es 25 65 00 25

Ref: Interim Materials on Highway Capacity, TRB Circular 212, Jan 1980

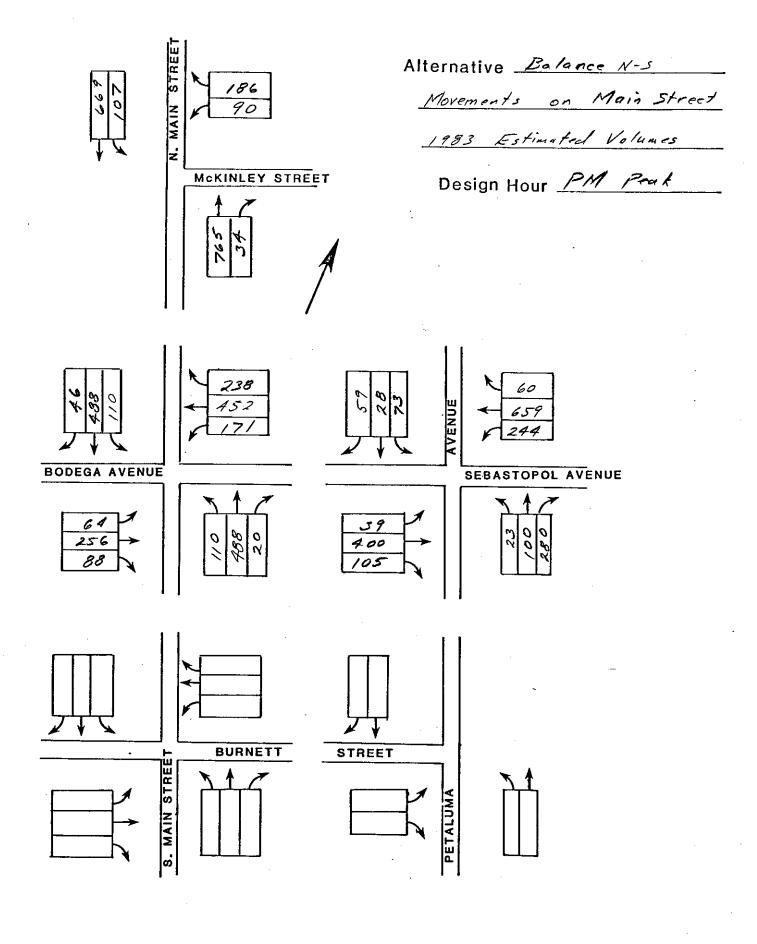
CRITICAL MOVEMENT ANALYSIS (3 Phase Signal, Tee intersection)

Intersection:		Width		
A: Main Street	Sb			
B: Main Street	Nb	A		В
C: McKinley Street	Wb	50	C	

Design Hour: P M Peak Problem Statement: 1983 Estimated Volumes (2)

Movement		Lanes		Lane Volume	Pedestrian Equivalent		Probable Cycle Length:
A Through A Right Turn	2	.5 .5	826 34	860 0	٠		100 sec
B Left Turn B Through	1 6	1	58 718	58 718			
C Left Turn	3	1	90	90	C Ped 8W	252	
C Right Turn		1	125	125	C red ow	232	

Probable Phase	Critical Volume	Carry- over	Crit Vol with Ped		
1+6 6+2	58 860	660	58 860		
	-	,	0		
3+8	90	35	252		LEVEL OF
8 RT on 1		TRUE			LEVEL OF
Sum of Crit. Vol.:	1008		1170		CE RANGES
Volume/Capacity:	0.71		0.82	(3 phases)
Level of Service:	С		D		
				Level	Sum of
Annual Growth Rate	2.45 %			of	Critical
	v/c exceeds			Service	Volumes
NA				Α	855
NA NA				В	1000
6				Č	1140
			•	Ď	1275
10				Ē	1425
15	1.00			<u>.</u>	1423



Intersection: A: Bode B: Sebas C: South D: Main Design Hour: Problem State	stopol h Main Stree P ment:	Avenue Street t M Peak		o o o umes ents	A	D C	В
Movement		Lanes	Volume	Lane Volume			
A Left Turn A Through A Right Turn	5 2	1 .5 .5	64 256 88	64 344 0			
B Left Turn B Through B Right Turn	1 6	1 1 1	171 452 238	171 452 238			
C Left Turn C Through C Right Turn	3 8	1 1 1	110 488 20	110 488 20			
D Left Turn D Through D Right Turn	7 4	1 1 1	110 488 46	110 488 46			
	Phase 1+5	Critical Volume 64 107 345	Carry- over 107 345				
- 3+8 o	3+7 r 4+7 4+8	110 0 488	0 488	·			LEVEL OF
Sum of Crit. Volume/Capaci Level of Serv	ty:	1114 0.81 D		·			CE RANGES + phases)
Annual Growth Years Before:	Rate	2.45 : /c exceed: 0.60				Level of Service A B C D	Sum of Critical Volumes 825 965 1100 1225 1375

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal, Tee intersection)

Intersection: A: Main S B: Main S C: McKin	Street	reet	SI Ni Wi		Width 50	A	С		
Design Hour: Problem Stateme	ent: 19			nts on Mai			(2a)		
Movement		Lanes	Volume	Lane Volume		strian valent	Probable Cycle Length:		
A Through A Right Turn	2	.5 .5	765 34	799 0			100 sec		
B Left Turn B Through	1 6	1 1	107 669	107 669					
C Left Turn C Right Turn	3	1 1	90 186	90 C 186	Ped 8W	252			
c Right furn		1	100	100					
		ritical	Carry-		 rit Vol				
Pł	1+6 6+2	Volume 107 799	over 562	W	107 799				

SERVICE RANGES Volume/Capacity: 0.70 0.81 (3 phases) Level of Service: B-C D Level Sum of Annual Growth Rate 2.45 % Critical of Years Before: v/c exceeds Service **Volumes** NA 0.60 Α 855 1 0.70 В 1000 6 0.80 C 1140 11 0.90 D 1275 15 1.00 Ε 1425

0

LEVEL OF

252

1158

Ref: Interim Materials on Highway Capacity, TRB Circular 212, Jan 1980

96

TRUE

90

996

3+8

8 RT on 1

Sum of Crit. Vol.:

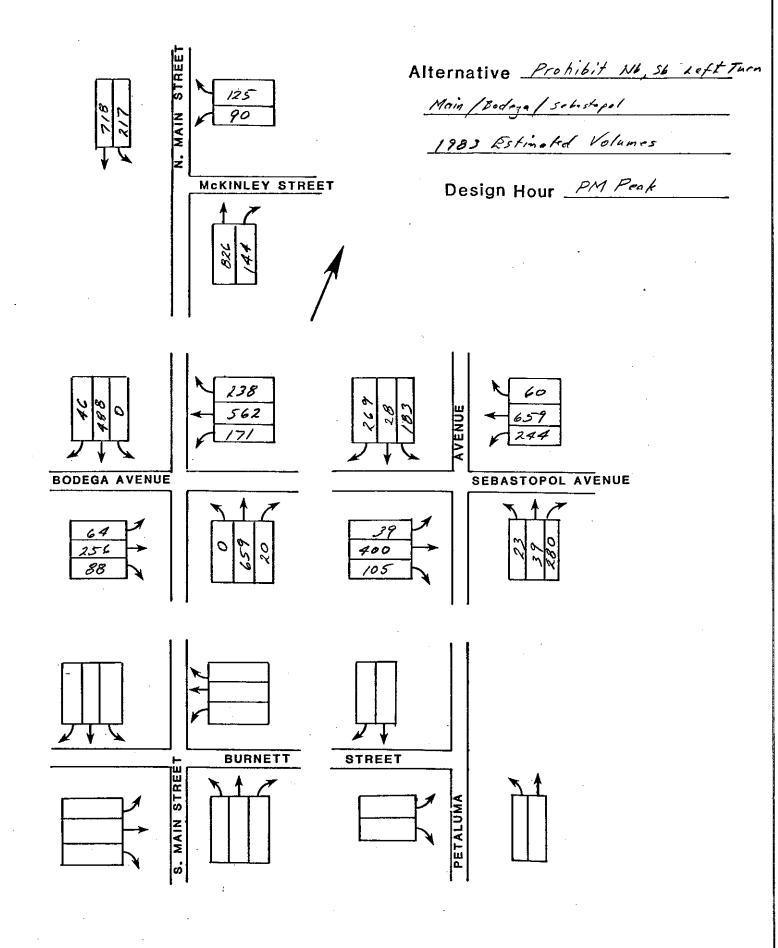
CRITICAL MOVEMENT ANALYSIS (6 Phase Dual Left Split Cross Street Signal)

	•		•			•	•		
Intersection:							-		
A: Sebasto	pol Av	enue	Eb)				١.,	
B: Sebasto			Wb			Α			В
C: Petalum			NE)			C	•	
D: Petalum	a Aven	ue	St)					
Design Hour:	РМ	Peak		r					
Problem Statemen								(2a)	
	Bal	ance N-	S Movemer	its on Maii	n Street				
·				Lane					
Movement		Lanes	Volume	Volume					
A last Tues		1	20	20					
A Left Turn	5 2	1	39 400	39 505					
A Through	۷	. 5 . 5	400 105	0					
A Right Turn		. 5	100	·					
B Left Turn	1	1	244	244	•				
B Through	6	$1.\overline{5}$	659	360					
B Right Turn	U	.5	60	0					
b Right fulli			00						
C Left Turn	3	.5	23	0					
C Through	8	.5	100	123					
C Right Turn	•	1	280	280					
o Right Tarn		•	200	230					
D Left Turn	7 .	.3	73	0					
D Through	4	. 4	28	160	•				
D Right Turn		.3	59	0					
Probab			Carry-						
Pha		olume	over						
_	+5	39	205						
1+6 or 2		205	155						
. 6	+2	505		•					
4	. 7	160	O.		•		_		
4	+7	160	0.						
2	8+8	123	157						
8 RT on		123	TRUE					LEVEL	OF
Sum of Crit. Vol		1032	INOL				SERV	CE RAN	
Volume/Capacity:		0.75			•			+ phas	
Level of Service		C.73						·	
ECVET OF SCIVIOC	•	· ·					Level	Sun	n òf
Annual Growth Ra	ite	2.45 %	, I				of	Criti	
Years Before:		exceeds					Service	Volu	ımes
	NA	0.60					Α		825
	NA	0.70					В		965
	3	0.80					C		1100
	8	0.90					D		1225
	12	1.00					E]	1375

Intersection: A: Bodega B: Sebast C: South D: Main S Design Hour: Problem Stateme	topol Main Stree P ent:	Avenue Street t M Peak 1983 Estima		mes Street,	A Both sides	D C	B (3)
Movement		Lanes	Volume	Lane Volume			
A Left Turn A Through A Right Turn	5 2	1 .5 .5	64 256 88	64 344 0	·		
B Left Turn B Through B Right Turn	1 6	1 1 1	171 452 238	171 452 238			
C Left Turn C Through C Right Turn	3 8	1 1.5 .5	110 549 20	110 285 0			
D Left Turn D Through D Right Turn	7 4	1 1.5 .5	159 488 46	159 267 0			
	hase 1+5	Critical Volume 64 107 345	Carry- over 107 345				
3+8 or	3+7 4+7 4+8	110 49 285	49 218				LEVEL OF
Sum of Crit. V Volume/Capacit Level of Servi	y:	960 0.70 B		٠			CE RANGES + phases)
Annual Growth Years Before:	Rate	2.45 % 7/c exceeds 0.60 0.70 0.80 0.90 1.00				Level of Service A B C D	Sum of Critical Volumes 825 965 1100 1225 1375

Intersection: A: Bodeg B: Sebas C: South D: Main Design Hour: Problem Statem	topol Main Stree P	Avenue Street t M Peak		o o omes	West Side	A	D C (3a)
Movement		Lanes	Volume	Lane Volume			
A Left Turn A Through A Right Turn	5 2	1 .5 .5	64 256 88	64 344 0			
B Left Turn B Through B Right Turn	1 6	1 1 1	171 452 238	171 452 238			
C Left Turn C Through C Right Turn	3 8	1 1 1	110 549 20	110 549 20			e e
D Left Turn D Through D Right Turn	7 4	1 1.5 .5	159 488 46	159 267 0			
	hase 1+5	Critical Volume 64 107 345	Carry- over 107 345				
3+8 or	3+7 4+7 4+8	110 49 549	49 218				
Sum of Crit. Vo Volume/Capacity Level of Service	y:	1224 0.89 D		·			LEVEL OF CE RANGES I+ phases)
Annual Growth I Years Before:	-	2.45 % /c exceeds 0.60 0.70 0.80 0.90 1.00				Level of Service A B C D	Sum of Critical Volumes 825 965 1100 1225 1375

Intersection: A: Bodega Av B: Sebastope C: South Mai D: Main Stree Design Hour: Problem Statement:	ol Avenue in Street eet P M Peak		mes Street,	A C	В
Movement	Lanes	Volume	Lane Volume		
A Left Turn 5 A Through 2 A Right Turn		64 256 88	64 344 0		
B Left Turn 1 B Through 6 B Right Turn		171 452 238	171 452 238		
C Left Turn 3 C Through 8 C Right Turn		110 549 20	110 285 0		
D Left Turn 7 D Through 4 D Right Turn		159 488 46	159 488 46		
Probable Phase 1+5 1+6 or 2+5 6+2	64 107	Carry- over 107 345			
3+7 3+8 or 4+7 4+8	49	49 439			ו דערו סר
Sum of Crit. Vol.: Volume/Capacity: Level of Service:	1114 0.81 D			_	LEVEL OF CE RANGES + phases)
Annual Growth Rate Years Before: NA NA NA	v/c exceeds 0.60 0.70 0.80 0.90			Level of Service A B C D	Sum of Critical Volumes 825 965 1100 1225 1375



Intersection: A: Bodega B: Sebast C: South D: Main S Design Hour: Problem Stateme	opol Main treet P nt:]	Avenue Street t M Peak		o o o o o o o o o o o o	·	A C	В
Movement		Lanes	Volume	Lane Volume		•	
A Left Turn A Through A Right Turn	5 2	1 .5 .5	64 256 88	64 344 0			
B Left Turn B Through B Right Turn	1 6	1 1 1	171 562 238	171 562 238			
C Left Turn C Through C Right Turn	3 8	1 1 1	0 659 20	0 659 20			
D Left Turn D Through D Right Turn	7 4	1 1 1	0 488 46	0 488 46			
Ph 1+6 or	ase 1+5	Critical Volume 64 107 455	Carry- over 107 455				•
3+8 or	3+7 4+7 4+8	0 0 659	0 488	-			LEVEL OF
Sum of Crit. Vo Volume/Capacity Level of Servic	:	1285 0.93 E				(4	CE RANGES + phases)
Annual Growth R Years Before:		2.45 % /c exceeds 0.60 0.70 0.80 0.90 1.00				Level of Service A B C D E	Sum of Critical Volumes 825 965 1100 1225 1375

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal, Tee intersection)

Intersection:					Width			
	A: Main Street B: Main Street)		Ą		В
C: McKinle		reet	N b W b		50	•	C	
Design Hour: Problem Statemer	t: 1	983 Estim		in/Bodega,			•	4)
Movement		Lanes	Volume	Lane Volume		strian valent		obable Cycle
								ength: 00 sec
A Through A Right Turn	2	.5 .5	826 144	970 0				
B Left Turn	1	1	217	217				
B Through	6	1	718	718				
C Left Turn	3	1	90	90 C	Ped 8W	252		
C Right Turn		1	125	125				

Probable	Critical	Carry-	Crit	Vo1		
Phase	Volume	over	with			
1+6	217	501		217		
6+2	970			970		
		•				
				0		
3+8	90	35		252		
8 RT on 1		TRUE				LEVEL OF
Sum of Crit. Vol.:	1277		1	439	SERVI	CE RANGES
Volume/Capacity:	0.90		1	.01	(3 phases)
Level of Service:	D-E			E		
					Level	Sum of
Annual Growth Rate	2.45 %				of	Critical
Years Before:	v/c exceeds				Service	Volumes
NA	0.60				Α	855
NA	0.70	_			В	1000
NA	0.80				C	1140
1	0.90				D E	1275
5	1.00				E	1425

CRITICAL MOVEMENT ANALYSIS (6 Phase Dual Left Split Cross Street Signal)

			•		3	,	
Intersection:							
A: Sebas			Et		_	D	
B: Sebas C: Petal			WE NE		A	С	В
D: Petal			Sk			·	•
Design Hour:	Р	M Peak					
Problem Statem					/6		(4)
		NO LI NO A	SD at Ma	Lane	a/Sebastopol		
Movement		Lanes	Volume	Volume			
A Loft Tunn							
A Left Turn A Through	5 2	. 1 . 5	39 400	39 505			
A Right Turn		.5	105	0			
D 1 . C4 . T	_						
B Left Turn B Through	1 6	1 1.5	244 659	244 360			
B Right Turn	O	.5	60	300			
- Kight lain		.0	00	Ū			
C Left Turn	3	.5	23	0			
C Through	8	.5	39	62			
C Right Turn		1	280	280			
D Left Turn	7	.3	183	0			
D Through	4	. 4	28	480			
D Right Turn		.3	269	0			
Prob	able	Critical	Carry-				
P	hase	Volume	over				
1+6 or	1+5	39	205				
1+0 01	6+2	205 505	155				
	4+7	480	_ 0				
	3+8	62	218				
8 RT	on 1	V.	TRUE			•	LEVEL OF
Sum of Crit. V		1291					CE RANGES
Volume/Capacit Level of Servi		0.94 E				(4	+ phases)
revel of Servi	ce.	C				Level	Sum of
Annual Growth		2.45 %				of	Critical
Years Before:		/c exceeds				Service	Volumes
	NA NA	0.60 0.70				A	825 965
	NA	0.70				B C D	1100
	NA	0.90			·	Ď	1225
	3	1.00				É	1375

					_				
Intersection: A: Bodeg B: Sebas C: South D: Main Design Hour: Problem Statem	topol Main Street P ment: 1	Avenue Street M Peak		o o umes Sb. Add 1	anes Nb	A & Sb	C		В
Movement		Lanes	Volume	Lane Volume				•	
A Left Turn A Through A Right Turn	5 2	1 .5 .5	64 256 88	64 344 0					
B Left Turn B Through B Right Turn	1 6	1 1 1	171 562 238	171 562 238					
C Left Turn C Through C Right Turn	3 8	0 1.5 .5	0 659 20	0 340 0					
D Left Turn D Through D Right Turn	7 4	0 1.5 .5	0 488 46	.0 267 0					
	hase 1+5	ritical Volume 64 107 455	Carry- over 107 455			-			-
3+8 or	3+7 4+7 4+8	0 0 340	0 267					LEVEL	OE.
Sum of Crit. V Volume/Capacit Level of Servi	:y:	966 0.70 C						CE RANG	GES
Annual Growth Years Before:	Rate	2.45 % c exceeds 0.60 0.70 0.80 0.90 1.00					Level of Service A B C D	1 1	cal

Ε

1425

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal, Tee intersection)

Intersection: A: Main St			St		Width	٨	
B: Main St C: McKinle		t	Nt Wt		50	Α (; B
Design Hour: Problem Statemen	No L	Estim T Nb &	Sb at Ma	in/Bodega Lane	a/Sebastor Ped	ool destrian	(4a) Probable
Movement	L 	anes 	Volume	Volume	۱p.: 	uivalent 	Cycle Length:
A Through A Right Turn	2	1	826 144	826 144			100 sec
B Left Turn B Through	1	1	217 718	217 718			
C Left Turn	3	1	90	90	Ped 8W	252	
C Right Turn		1	125	125			
D L	1-0-14						
Probab Pha	le Crit se Vo	lume	Carry- over		Crit Vol with Ped		
	+6 +2	217 826	501		217 826		
٩	- :+8	90	35	·	0 252		
8 RT on Sum of Crit. Vol	1	1133	TRUE		1295	SERV	LEVEL OF
Volume/Capacity: Level of Service		0.80 C-D			0.91 E		(3 phases)
Annual Growth Ra Years Before:	te v/c e NA NA 1	2.45 % exceeds 0.60 0.70 0.80 0.90			E	Level of Service A B C	Sum of Critical Volumes 855 1000 1140 1275

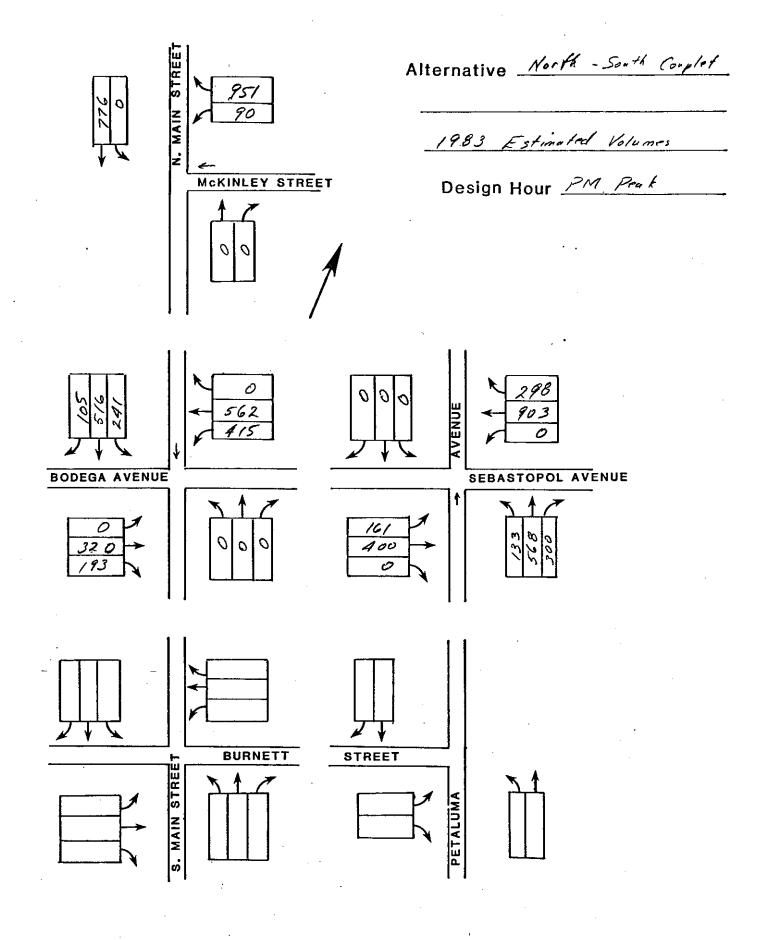
Ref: Interim Materials on Highway Capacity, TRB Circular 212, Jan 1980

1.00

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CRITICAL MOVEMENT ANALYSIS (6 Phase Dual Left Split Cross Street Signal)

Intersection: A: Sebas: B: Sebas: C: Petal: D: Petal: Design Hour: Problem Stateme	topol uma A uma A P ent:	Avenue venue venue M Peak 1983 Estim	Eb Wb Nb Sb Sb ated Volu Sb at Ma	mes. 2 in/Bodec	lanes Sb o a/Sebastop	A A n Petaluma ol	B
Movement		Lanes	Volume	Lane Volume		•	
A Left Turn A Through A Right Turn	5 2	.5 .5	39 400 105	39 505 0		. ,	
B Left Turn B Through B Right Turn	1 6	1 1.5 .5	244 659 60	244 360 0			
C Left Turn C Through C Right Turn	3 8	.5 .5 1	23 39 280	0 62 280			
D Left Turn D Through D Right Turn	7 4	.5 .5	183 28 269	183 297 0			
	hase 1+5	Critical Volume 39 205 505	Carry- over 205 155				
	4+7	297	0				
8 RT of Sum of Crit. Vo Volume/Capacity Level of Service	ol.: y:	62 1108 0.81 D	218 TRUE			_	LEVEL OF CE RANGES I+ phases)
Annual Growth 1 Years Before:	Rate	2.45 % //c exceeds 0.60 0.70 0.80 0.90 1.00				Level of Service A B C D	Sum of Critical Volumes 825 965 1100 1225 1375



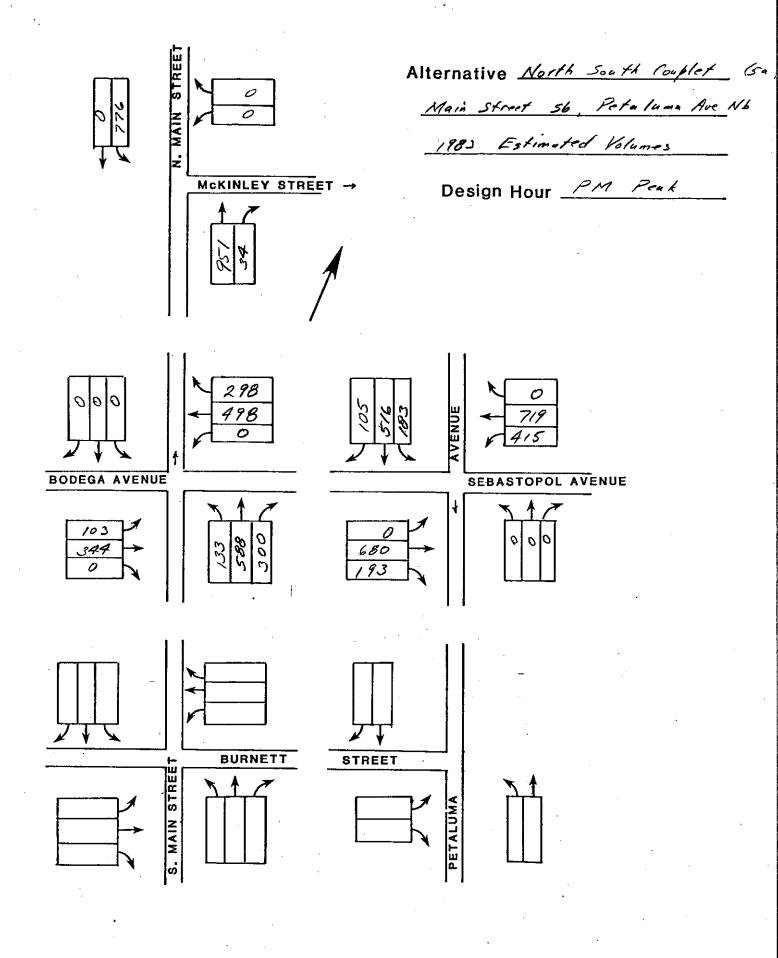
					-				
Intersection:	. + 1	Augus	1.11	_					
A: Sebas B: Bodeg			Wi Et			Α	D _.	•	В
C: Main			Si			^	С		b
D: South				-			_		
Design Hour:		M Peak		,					
Problem Statem				umes				(5)	
	NO	rth-South	Couplet	Lane					
Movement		Lanes	Volume	Volume	-				
						•			
A Left Turn	5	1	415	415					
A Through	2	1 0	562 0	562 0					
A Right Turn		U	. 0	U					
B Left Turn	1	0	0	0	,				
B Through	, 6	1	320	320					
B Right Turn		1	193	193					
C Left Turn	3	5	241	0	•				
C Through	8	. 2	516	287					
C Right Turn		.5 2 .5	105	0					
D. I. Ct. T	-	•	•	0					
D Left Turn	7 4	0	0 0	0					
D Through D Right Turn	4	0	0	0					
		Critical	Carry-						
F	Phase	Volume	over		•				
116 -	1+5	0	415						
1+6 oı	r 2+5 6+2	415 320	147						
	UTZ	320							
								_	
	210	287							
	3+8	201						LEVEL	0F
Sum of Crit.	Vol.:	1022					SERVI	CE RAN	
Volume/Capacit		0.72				•	(;	3 phas	es)
Level of Serv	ice:	C							
Annual Growth	Rato	2.45 %					Level of	Sum Criti	
Years Before:		۾ دو.جن c exceeds/				Se	rvice	Volu	
	NA ,	0.60					Ā		855
	NA	0.70					В	1	000
	5	0.80					Č		140
	10	0.90					D		275
	14	1.00					E	1	425

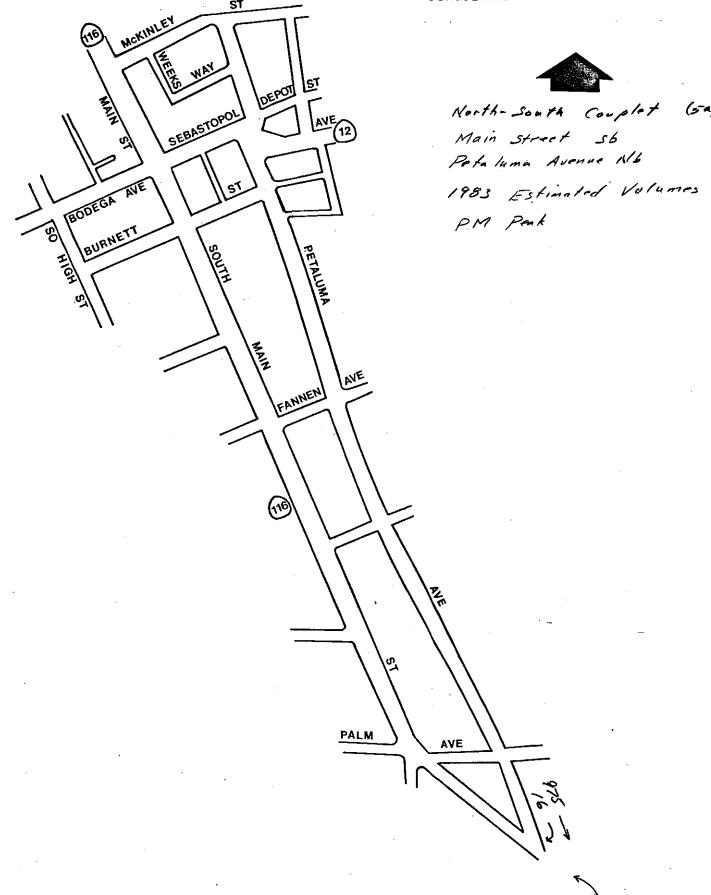
CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

	•	•	,,	,		
Intersection: A: Main Str	eet.			Width		
B: Main Str	eet		Sb		Α	В
C: Mc Kinle	y Street		Wb	50		С
Design Hour: Problem Statement	P M Peak • 1983 Fe		lumes '			(5)
. For tem our demend		Way Coupl	et	_		
Movement	Lane	es Volume	Lane Volume		destrian Juivalent	Probable Cycle
			*			Length: 100 sec
						100 Sec
B Through	6	2 776	388			
- / 						
C Left Turn	3	1 90	90			
C Right Turn	8	1 951	951	C Ped 8W	252	
•						
Probabl Phas	e Critica e Volum			Crit Vol	•	
				W. OII 1 CQ		
	6 38	8		388		
					•	
3+, o n	-	0 861		90		
8 R 8 RT on	6	0 388		473		LEVEL OF
Sum of Crit. Vol. Volume/Capacity:	: 95 0.6			951 0.63		ICE RANGES (2 phases)
Level of Service:	В			В		
Annual Growth Rat		45 _, %			Level of	Sum of Critical
Years Before:	v/c exce A 0.6				Service A	Volumes 900
	5 0.7	0				1050
1	5 0.9	10			B C D	1200 1350
1	9 1.0	IU			E	1500

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal)

Problem Statement:	Avenue Avenue Avenue PM Peak			А	C	. В
Movement	Lanes	Vo1ume	Lane Volume			
A Left Turn 5 A Through 2 A Right Turn	1 1 0	161 400 0	161 400 0			
B Left Turn 1 B Through 6 B Right Turn	0 1.5 .5	0 903 298	0 601 0			
C Left Turn 3 C Through 8 C Right Turn	.5 1.5 1	133 568 300	0 351 300			
D Left Turn 7 D Through 4 D Right Turn	0 0 0	0 0 0	0 0 0			
Probable Phase 1+5 1+6 or 2+5 6+2	Critical Volume 0 161 601	Carry- over 161 239				
3+8 Sum of Crit. Vol.: Volume/Capacity:	351 1112 0.78					LEVEL OF CE RANGES 3 phases)
Level of Service: Annual Growth Rate Years Before: V NA NA 2 6 11	2.45 % 7/c exceeds 0.60 0.70 0.80 0.90 1.00				Level of Service A B C D	Sum of Critical Volumes 855 1000 1140 1275 1425





D

Ē

1350

1500

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

		(2 Pi	nase Signa	il, No confl	icts)		
Intersection: A: Gravens B: South N C: Petalum	1ain	Street		Nb (2 lanes)	A	С	В
Design Hour: Problem Statemer	it:			; Main St NI	o, Petaluma	a Ave Sb	(5a)
Movement		Lanes	Volume	Lane Volume			
A Through	2	2	879	440			
							·
C Through C Right Turn	8	1	975 16	975 16			
	ole (Critical Volume	Carry- over				
·	2	440					
	8	975					
Sum of Crit. Vol Volume/Capacity	:	1415 0.94					LEVEL OF CE RANGES 2 phases)
Level of Service	•	E			•	Level of Service A B C	Sum of Critical Volumes 900 1050 1200

Volumes

900

1050

1200

1350 1500

Service

A

B C

D E

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

B: South	Main	Street		Wb (1 lane)	А		В
C: Petal	ıma A	venue	SI	b (2 lanes)		С	-
Design Hour: Problem Stateme	ent:	M Peak 1983 Estii North-Sou	mated Volu th Couple	umes t; Main St l Lane	Nb, Petalum	na Ave Sb	(5a)
Movement		Lanes	Volume	Volume			
A Through	2	1	879	879			
4							
			e.				
0 TI 1							
C Through C Right Turn	8	2 1	975 16	488 16			·
Proba	ble (Critical	Carry-				
Pł	iase	Volume	over				
	2	879					
·							
	8	488					LEVEL OF
Sum of Crit. Vo Volume/Capacity	/:	1367 0.91					CE RANGES 2 phases)
Level of Servic	e:	E				Level	Sum of
						of	Critical

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal)

B: Seb C: Sou	ega Ava astopo th Mai n Stre	l Avenue n Street et P M Peak 1983 Estii	EI WI NI mated Volu th Couplet	o umes t; Main St	Nb,	A Petaluma	C Ave Sb	(5a)	В
Movement		Lanes	Volume	Lane Volume					
A Left Turn A Through A Right Turn	5 2	1 1 0	103 344 0	103 344 0					
B Left Turn B Through B Right Turn	1 6	0 1 1	0 498 298	0 498 298					-
C Left Turn C Through C Right Turn	3 8	.5 2 .5	133 588 300	0 340 0					
D Left Turn D Through D Right Turn	7 4	0 0 0	0 0 0	0 0 0					
Pro	obable Phase	Critical Volume	Carry- over						
	2+5 6+2	103 498	241						
	3+8	340						A Priver	
Sum of Crit. Volume/Capac Level of Serv	ity:	941 0.66 B				- - -		LEVEL CE RANG 3 phase	ES
Annual Growth Years Before		2.45 % 7/c exceeds 0.60 0.70 0.80 0.90 1.00					Level of rvice A B C D	Sum Critic Volum 8 10 11 12	a1 es 55 00 40 75

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

Intersection:

A: Main Street Nb
B: Main Street Sb A C: McKinley Street C

Design Hour: P M Peak

Problem Statement: 1983 Estimated Volumes (5a)

North-South Couplet; Main St Nb, Petaluma Ave Sb

Movement		Lanes	Volume	Lane Volume
A Through A Right Turn	2	1.5 .5	951 34	493 0
B Left Turn	1	1	776	776

,		Critical Volume	Carry- over	
,	1 2	776 493	, 0	

Sum of Crit. Vol.: Volume/Capacity: Level of Service:	1269 0.85 D		LEVEL OF CE RANGES 2 phases)
		Leve1	Sum of
Annual Growth Rate	2.45 %	of	Critical
Years Before: v/c	exceeds	Service	Volumes
NA	0.60	A	900
NA	0.70	В	1050
NA	0.80	Ċ	1200
3	0.90	D	1350
7	1.00	Ē	1500

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal)

	astopo astopo aluma / aluma /	Avenue P M Peak 1983 Est	E S imated Vol	t; Main St	A : Nb, Petalu	((5a)
Movement		Lanes	Volume	Lane Volume		•	
A Left Turn A Through A Right Turn	5 2	1 1 0	415 719 0	415 719 0			
B Left Turn B Through B Right Turn	1 6	.5 .5	0 680 193	0 873 0		•	
C Left Turn C Through C Right Turn	3 8	.5 1 .5	183 516 105	0 402 0			
D Left Turn D Through D Right Turn	7 4	0 0 0	0 0 0	0 0 0			
Pro	bable Phase	Critical Volume	Carry- over				
	2+5 6+2	415 873	304				
	3+8	402					LEVEL OF
Sum of Crit. Volume/Capaci Level of Serv	ty:	1690 1.19 E					LEVEL OF CE RANGES 3 phases)
						Level of Service A B C D	Sum of Critical Volumes 855 1000 - 1140 1275 1425

1350

1500

D

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal No conflicts)

		(2 Pr	nase Sign	al, No confl	icts)	
Intersection: A: Grave B: South C: Petal	Main	Street		Wb (2 lanes) b (2 lane)	A	С
Design Hour: Problem Stateme	ent: 1	M Peak 983 Estim orth-Sout	ated Volu h Couple	umes t; Main St N Lane	b, Petaluma A	(5b)
Movement		Lanes	Volume	Volume		
A Through	2	2	879	440		
C Through C Right Turn	8	2	975 16	488 16		
	ble Case	 ritical Volume	Carry- over			
	2	440				
	8	488				
Sum of Crit. Vo Volume/Capacity Level of Servic	:	927 0.62 B				LEVEL OF SERVICE RANGES (2 phases)
Annual Growth R Years Before:		2.45 % exceeds 0.60 0.70 0.80				evel Sum of Oritical Vice Volumes A 900 B 1050 C 1200

Ref: Interim Materials on Highway Capacity, TRB Circular 212, Jan 1980

16

20

0.90

1.00

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

Intersection:

A: Main Street Nb
B: Main Street Sb A B
C: McKinley Street Nb C

Design Hour: P M Peak

Problem Statement: 1983 Estimated Volumes (5b)

North-South Couplet: Main St Nb, Petaluma Ave Sb

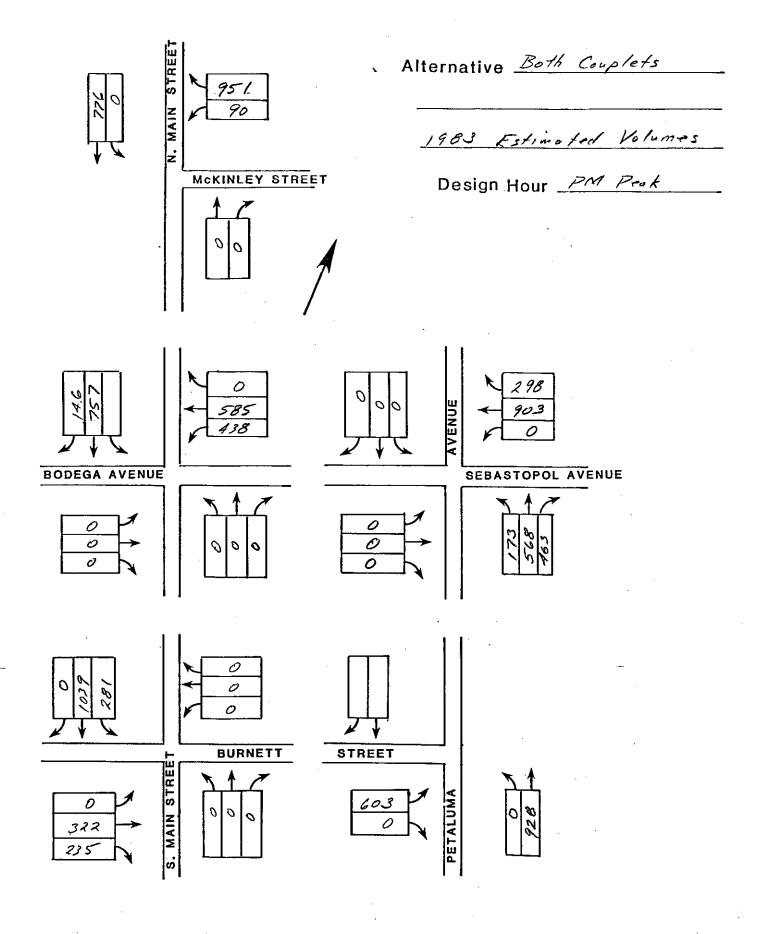
Movement	Phase	Lanes	Volume	Lane Volume
A Through A Right Turn	2	1.5 .5	951 34	493 0
B Left Turn	1	2	776	388

Probable Critical Carry-Phase Volume over 1 388 0 2 493

Sum of Crit. Vol.: Volume/Capacity: Level of Service:	881 0.59 A		LEVEL OF CE RANGES 2 phases)
		Leve1	Sum of
Annual Growth Rate	2.45 %	of	Critical
Years Before: v/c	exceeds	Service	Volumes
1	0.60	A	900
8	0.70	В	1050
13	0.80	C	1200
18	0.90	D	1350
23	1.00	E	1500

CRITICAL MOVEMENT ANALYSIS (3 Phase Signal)

Intersection: A: Sebast B: Sebast C: Petalu D: Petalu Design Hour: Problem Stateme	topol uma A uma A P	Avenue avenue avenue M Peak 1983 Esti	SI	add RT umes t; Main St	ŕ	A Petaluma	D C Ave Sb	(5b)
Movement		Lanes	Volume	Lane Volume				
A Left Turn A Through A Right Turn	5 2	1 1 0	415 719 0	415 719 0				
B Left Turn B Through B Right Turn	1 6	0 1 1	0 680 193	0 680 193				
C Left Turn C Through C Right Turn	3 8	.5 1 .5	183 516 105	0 402 0		·		
D Left Turn D Through D Right Turn	7 4	0 0 0	0 0 0	0 0 0				
	able hase	Critical Volume	Carry- over					
	2+5 6+2	415 680	304					
	3+8	402						LEVEL OF
Sum of Crit. Vo Volume/Capacity Level of Service	y:	1497 1.05 E	:			_		CE RANGES 3 phases)
Level of Servio	ce.					S	Level of ervice A B C	Sum of Critical Volumes 855 1000 1140
							D E	1275 1425



1350

1500

D

Ε

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

B: Mair C: Seba D: Bode Design Hour:	th Main 1 Street 2 stopol 2 ga Aver P 2 ement: 1	t Avenue nue M Peak 1983 Estin	Sb Avenue Wb ue				D C	В
Movement		Lanes	Volume	Lane Volume				
			· • • • • • • • • • • • • • • • • • • •					
B Through B Right Turn	6	2.5 .5	757 146	301				
C Left Turn C Through	8	1	438 585	512				
Pro		Critical Volume	Carry- over					
	6	301						
e Telephone Telephone	8	512			_			
Sum of Crit. Volume/Capaci Level of Serv	ity:	813 0.54 A					LEVEL ICE RAN (2 phase	GES es)
Annual Growth Years Before:		2.45 % exceeds 0.60 0.70 0.80				Level of Service A E	Critic Voluments	cal

Ref: Interim Materials on Highway Capacity, TRB Circular 212, Jan 1980

21

26

0.90

1.00

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

Intersection: A: Main Street			Width					
B: Mair	B: Main Street C: Mc Kinley Street			b b		50	A	С
Design Hour: Problem State		P M Peak 1983 Estim Both Couple						(6)
Movement		Lanes	Volume	Lane Volume			edestrian quivalent	Probable Cycle Length:
								100 sec
B Through	6	2	776	388				•
C Left Turn	3	1	90	90	0 B I	ou.	050	
C Right Turn	8	1	951	951	C Ped	8W	252	
Pro	hable	Critical	 Carry-		Crit	 Vol		
	Phase	Volume	over		with			
	6	388				388		
	3+8	90	861			90		
	8 RT on 6	473 0	388			473		LEVEL OF
Sum of Crit. Volume/Capaci	ty:	951 0.63 B				951 .63		ICE RANGES (2 phases)
Level of Serv						В	Level	
Annual Growth Years Before:		2.45 % c exceeds/					of Service	
	NA	0.60					A	900
	5 10	0.70 0.80					B C	1200
	15 19	0.90 1.00					D E	1350

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal without conflicts)

Intersection: A: Petalu B: Petalu C: Sebast D: Sebast Design Hour: Problem Stateme	ma Avo opol / opol / P l nt: 1	enue Avenue Avenue M Peak)	A	D C (6)
Movement		Lanes	Volume	Volume		
A Left Turn A Through A Right Turn	5 2	.5 1.5 1	173 568 463	0 371 463		
C Through C Right Turn	8	1.5 .5	903 298	601 0		
		ritical Volume	Carry- over			
2 RT o	5+2 n 8	371	93 TRUE	_		
	8	601				
Sum of Crit. Vo Volume/Capacity Level of Servic	':	971 0.65 B			(LEVEL OF ICE RANGES 4+ phases)
Annual Growth R Years Before:		2.45 % c exceeds 0.60 0.70 0.80 0.90 1.00			Level of Service A B C C C	Critical Volumes 900 1050 1200

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

Problem Statement:	Street reet reet M Peak			· ·	Α	D B C (6)
Movement	Lanes	Volume	Volume			
A Left Turn A Through 2	1 2	281 1039	281 520			
			,			
C Through 8 C Right Turn	1.5 .5	322 235	279			
Probable Phase	Critical Volume	Carry- over				
2	520					
8	279					
Sum of Crit. Vol.: Volume/Capacity: Level of Service:	798 0.53 A					LEVEL OF ICE RANGES (2 phases)
Annual Growth Rate	2.45 % //c exceeds 0.60 0.70 0.80 0.90 1.00				Level of Service A B C D E	Critical Volumes 900 1050 1200

CRITICAL MOVEMENT ANALYSIS (2 Phase Signal, No conflicts)

Intersection: A: Petaluma Avenue B: Petaluma Avenue C: Burnett Street			NI El		A	C	В
Design Hour: Problem Stateme	nt: 19	1 Peak 983 Estima oth Couple				(6)
Movement		Lanes	Volume	Lane Volume		·	
					•		
B Through	6	2	928	464			
						•	
C Left Turn	8	2	603	302			

Probable Phase	Critical Volume	Carry- over	•
6	464		
8	302		
Sum of Crit. Vol.: Volume/Capacity: Level of Service:	766 0.51 A		LEVEL OF SERVICE RANGES (2 phases)
Annual Growth Rate	2.45 % /c exceeds 0.60 0.70 0.80 0.90 1.00		Level Sum of of Critical Service Volumes A 900 B 1050 C 1200 D 1350 E 1500